# Report on the Biological Study (LBCRM-PL/ICRM-PL, Kuala Teriang, Langkawi, Malaysia)

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## Background

The LBCRM-PL project commenced operations in August 2003 under the collaborative framework of SEAFDEC/TD and the Department of Fisheries (DOF) Malaysia. Establishment of an artificial reef complex within the vicinity of the existing FADs in the waters of Kuala Teriang was among the activities conducted under the LBCRM-PL project in Pulau Langkawi. Site selection was conducted on 28 July 2003 by the staff of DOF Malaysia in collaboration with an Officer from DOF Thailand, Dr. Vicharn Insrisawang and SEAFDEC/TD Officer, Dr. Somboon Siriraksophon. The site chosen was at Lat. 6$^{o}$ 20' 17.5" N and Long. 99$^{o}$ 36' 37.5" E, where the water depth is 33 meters and the bottom sediment is sandy silt clay (4.3% silt, 14.5% clay and 81.2% sand, and others). Before the start of the project, a biological study was conducted by the staff of SEAFDEC/TD until the end of 2006.

Although the LBCRM–PL site is a restricted area, encroachment by trawlers was observed as reported during the 9$^{th}$ Coordination Committee Meeting held in Langkawi on 18 July 2007. Even purse seiners occasionally catch fish within the project site. From April 2004 until 2006, fishery resource surveys were conducted by SEAFDEC/TD. The activity aimed to ensure the sustainability of available marine resources, especially around the artificial reefs (ARs) and fish aggregating device (FADs).

After the biological study of SEAFDEC/TD until the end of 2006, this was continued in 2007 by researchers from the Fisheries Research Institute (FRI) of Penang, Malaysia. Only two study trips were however conducted in 2007 due to time and financial constraints. Meanwhile, in April 2007, 10 more concrete artificial reef units were deployed at Lat. 6$^{o}$ 20.5' N and Long. 99$^{o}$ 37.658' E. The objectives of this study were:

a. To assess the effectiveness of artificial reefs in aggregating fishes;
b. To assess the functionality of the artificial reefs as spawning and nursery grounds for fish and other marine organisms (long-term); and
c. To assess the sustainability of the fishery stock in the LBCRM-PL project site.

## The Fisheries Research Institute Team

The members of the Team from FRI involved in the biological study comprise:

| | |
|---|---|
| Abdul Razak Bin Latun | Senior Research Officer |
| Ahmad Husin Alias | Senior Research Officer |
| Hadzley Harith | Assistant Research Officer |
| Malek Daud | Senior Laboratory Assistant |

## Research Methodology

### *The study area*

The study area (Fig. 1) was within the selected site for artificial reef construction, i.e. off Kuala Teriang, Pulau Langkawi at coordinates: Lat. 6$^{o}$20'17.5" N and Long. 99$^{o}$36'37.5" E. The depth of the water is 33 meters and the bottom sediment is silt clay. The locations of the FADs and ARs as well as the fishing gear operations in the project site are shown in Table 1. The fishing grounds of Pulau Langkawi are shown in Fig. 2.

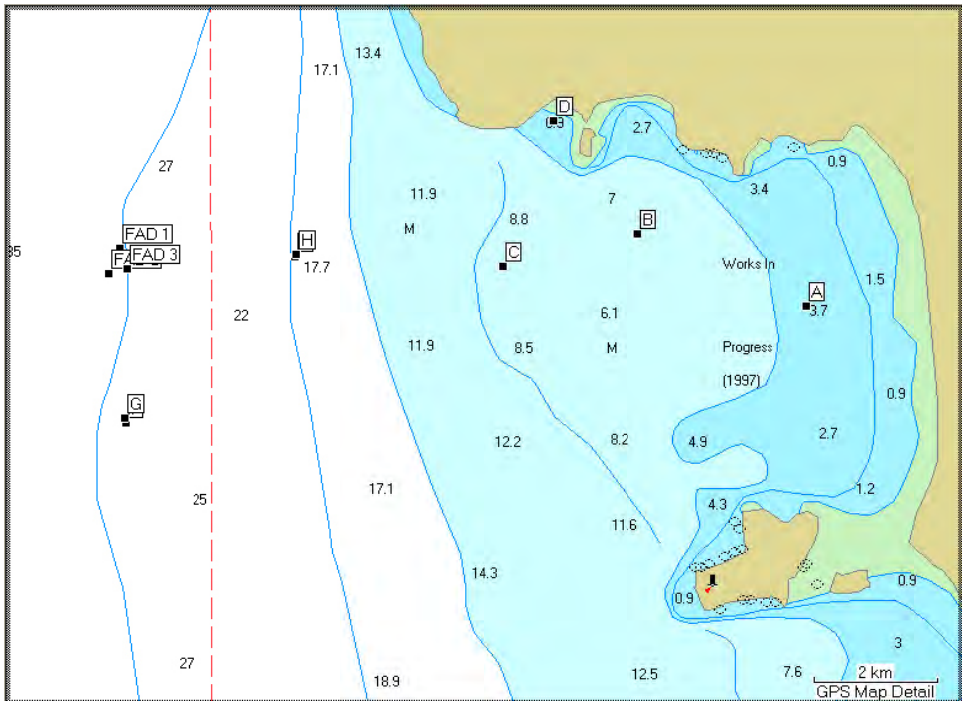


**Fig. 1. Map of the study site at Kuala Teriang, Langkawi**

**Table 1. Locations of existing FADs, proposed ARs sites, and fishing gear operations**

| Stations | Item/Tasks | Latitude | Longitude |
|---|---|---|---|
| FAD I | FAD | 6° 20.547' N | 99° 36.102' E |
| FADII | FAD | 6° 20.329' N | 99° 36.002' E |
| FAD III | FAD | 6° 20.363' N | 99° 36.161' E |
| A | | 6° 20.521' N | 99° 42.182' E |
| B | | 6° 20.680' N | 99° 40.690' E |
| C | | 6° 20.390' N | 99° 39.493' E |
| D | | 6° 21.692' N | 99° 39.942' E |
| E | | 6° 20.476' N | 99° 37.648' E |
| F | Proposed AR area | 6° 18.991' N | 99° 36.153' E |
| G | Proposed AR area | 6° 19.033' N | 99° 36.144' E |
| H | | 6° 20.5' N | 99° 37.658' E |

### Conventional Water Quality Parameters and Nutrient Levels

Conventional water quality parameters such as temperature, oxygen, depth, salinity and pH were measured using a YSI 600 data sounder. These parameters characterized the existing conditions of the waters during the data collection. Water samples were collected from each sampling station and analyzed for ammonia, nitrite, nitrate, and phosphate using standard laboratory methods from APHA journal.

### Catch rate study at Artificial Reefs and FADs areas

The catch rate study was conducted using baited single hook hand-line at the artificial reefs and FADs areas. The catch rate was expressed as weight of catch (kg) per angler per hour.

### Fish landing data

Fish landing data were collected near the Kuala Teriang Jetty, from three sources, i.e. fisherman logbook, middleman logbook, and fish landing survey. The fish landing survey was initiated by SEAFDEC/TD from April 2004 until 2006, after which in 2007 the fish landing survey was continued by FRI. For monitoring purposes, all landing data were analyzed according to catch composition; CPUE (catch per unit effort); and total landing and total value.

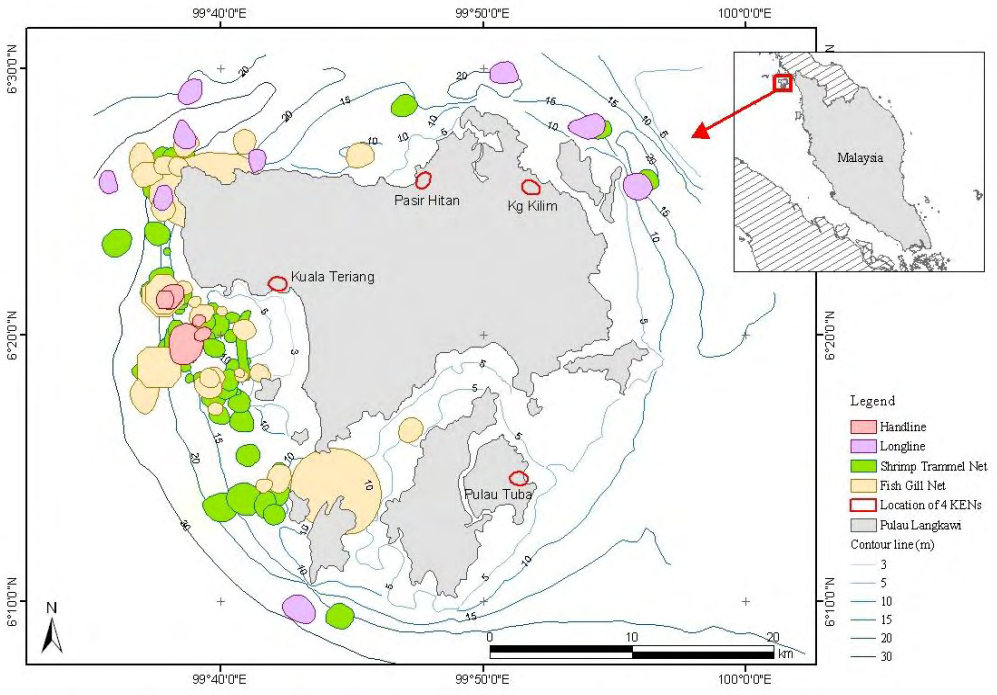


**Fig. 2. Fishing grounds of Pulau Langkawi, Malaysia**

## Results

### *Conventional Water Quality Parameters and Nutrient Levels*

The conventional water quality parameters (temperature, conductivity, salinity, D.O. pH) and nutrient levels ($NO_3$, $NO_2$, $NH_3$) in the FADs and ARs areas are shown in Table 2.

**Table 2. Water quality parameters and nutrient levels in the FADs and ARs locations**

| Stations | Temperature (℃) | Conductivity µS/cm | Salinity (ppt) | D.O. (ppm) | pH | $NO_3$ (ppm) | $NO_2$ (ppm) | $NH_3$ (ppm) |
|---|---|---|---|---|---|---|---|---|
| FAD I | 28.45 | 46.64 | 30.21 | 2.31 | 8.05 | 1.9 | 0.88 | 0.34 |
| FADII | 28.56 | 47.34 | 30.18 | 2.55 | 8.22 | 1.65 | 0.44 | 0.28 |
| FAD III | 28.53 | 46.88 | 30.08 | 2.34 | 8.23 | 1.68 | 0.56 | 0.22 |
| A | 28.61 | 46.98 | 30.32 | 3.11 | 8.43 | 3.05 | 1.04 | 0.46 |
| B | 28.54 | 46.87 | 30.23 | 3.43 | 8.32 | 1.11 | 0.56 | 0.34 |
| C | 28.68 | 47.59 | 30.12 | 3.20 | 8.31 | 2.04 | 0.46 | 0.24 |
| D | 25.58 | 47.68 | 30.24 | 3.22 | 8.06 | 1.38 | 0.68 | 0.42 |
| E | 28.55 | 47.54 | 30.22 | 3.43 | 8.08 | 1.24 | 0.52 | 0.34 |
| F (Proposed AR area) | 28.77 | 47.65 | 30.43 | 2.89 | 8.05 | 1.88 | 0.24 | 0.26 |
| G (Proposed AR area) | 28.92 | 47.66 | 30.28 | 2.99 | 8.12 | 1.94 | 0.45 | 0.28 |
| H | 28.53 | 47.87 | 30.45 | 2.88 | 8.23 | 1.89 | 0.32 | 0.42 |

### Catch rate study at Artificial Reefs and FADs areas

The result from the catch rate study (Table 3) was rather scanty. Due to budget and time constraints this study was conducted only on one occasion in 2007.

**Table 3. Catch rate study indicating the species composition (sampled on 13/6/07)**

| Species composition | No. of fish | Total weight (g) |
|---|---|---|
| *Atule mate* | 16 | 1600 |
| *Megalaspis cordyla* (torpedo scad) | 12 | 2200 |
| *Rastrelliger kanagurta* (Indian mackerel) | 2 | 300 |
| *Lutjanus lutjanus* (big eye snapper) | 1 | 150 |
| *Nemipterus japonicas* (threadfin bream) | 1 | 90 |

However, the result also indicated that the catch rate per angler (in the vicinity of the ARs and FADs ) = 0.7233 kg/hr/angler. Angling was not done in areas without ARs or FADs.

**Fish landing data**

Conducted at the start of the project, the pre-survey information showed that most fishermen in the village sell their catch to four middlemen in the village. Therefore, the data from those middlemen were taken to represent the total landing of the fishermen in the village. During the December 2004 Tsunami, many fishermen lost their boats and some middlemen lost their landing sites. Since then, two of the contact middlemen have changed their jobs. Hence, from August 2005 landing data were collected from the two remaining middlemen, thereby the data could no longer be assumed to represent the total landings of the fishermen in the project site. However, the trend of catch and its value could still be observed from the data collected from the remaining two middlemen.

Every two to four months, staff from SEAFDEC/TD, FRI and DOF Malaysia conducted fish landing survey for three (3) days. The catch from fishermen was sampled and measured for length and weight as well as species composition from each type of fishing gear.

***Catch composition***

Shrimp trammel net

The fisherman logbooks were the source of data for the catch composition. For the period between 2004 and 2006, Penchan (2006) cited that the catch composition from the shrimp trammel net include both demersal and pelagic fishes such as the Indo-pacific mackerel, Indian mackerel, gizzard shad, four finger fish, triple tail fish, croaker, marine catfish, sole, mullet, bream, bay sillago, banana prawn, western king prawn, greasy black shrimp, ray, shark, mantis shrimp, swimming crab, and mask crab. Shrimps and prawns are abundant all year round in Kuala Teriang waters. Penchan (2006) also reported that high percentage of banana and western king prawn (more than 20% of the catch) was observed from August to November 2006, and the greasy black shrimp (more than 70% of the catch) in November 2005 and from January to February 2006. Indian and Indo-pacific mackerels constitute less than 25% of the catch in 2005 and 2006 but constitute more than 25% of the catch in 2004. In the 2007 landings, the catch composition of shrimp trammel net included two species of crabs, banana and western king prawns, Indian mackerel, jew fish and flounder, showing less diversity in the 2007 catch as compared to the 2004, 2005 and 2006 catches.

**CPUE**

Shrimp trammel net

The CPUE data showed that shrimp is abundant all year round in Kuala Teriang waters (Penchan, 2006). The average CPUE of shrimp trammel net (Table 4) was between 0.36 kg/net/trip in August 2006 to 2.47 kg/net/trip in June 2004. Shrimps being the target species for trammel netting contributed CPUE of 0.11 kg/net/trip in November 2004 to 0.65 kg/net/trip in August 2004.

**Length distribution**

The total length of the greasy back shrimp was between 7.50 – 19.00 cm, and 11.50 to 23.50 cm for banana prawn. The average total length in June 2004, December 2004, August 2005, November 2005 and April 2006 of the greasy back shrimp were 11.85 , 11.38, 11.27, 11.75 and 15.83 cm, respectively while those of the banana prawn were 14.01, 16.19, 16.17, 15.67 and 17.78 cm, respectively.

The percentage length distribution of the greasy back shrimp and banana prawn showed that their sizes in 2006 were bigger than those in 2005 and 2004. The carapace width of swimming crabs was 9.50 to 18.00 cm. The average width of swimming crab in June 2004, December 2004, August 2005, November 2005 and April 2006 were 13.24, 13.42, 13.18, 13.14 and 14.25 cm, respectively. The total length of Indo-pacific mackerel in 2005 and 2006 were between 13.00 and 22.00 cm, respectively with the average length in June 2004, August 2005 and April 2006 at 16.97, 14.62 and 15.32 cm, respectively.

**Discussions**

The biological survey showed that the area in the vicinity of the artificial reef sites is rich in fishery resources. Data gathered during the biological baseline survey will be utilized in the future, to assess the effectiveness of the artificial reefs deployed in Kuala Teriang waters. More work and analysis are still needed in the future, considering that most of the fishes were caught at the sites near the existing FADs. The success of the FADs and artificial reefs in enhancing the fish stocks also depends on the surveillance efforts conducted by DOF Malaysia. Encroachment of trawlers and purse-seiners in the project site, which could still be observed should be deterred.

The catch during the transition period from Northeast monsoon season to Southwest monsoon season (March to May) showed that the catch composition of shrimp and prawn was lower than during the other months. The average CPUE of shrimp and prawn from the shrimp trammel net in March to May 2006 are between 0.27 – 0.42 kg/net/trip which it is not significantly different from the average CPUE of all data, i.e. 0.36 kg/net/trip. Therefore, it could be said that shrimps and prawns are abundant in the Kuala Teriang waters all year round (Penchan, 2006).

Table 4 shows that the average CPUE of shrimp trammel net in 2005 and 2006 was lower than in 2004. The total landing of shrimp and prawn as the target species of trammel net, considering the number of licensed shrimp trammel net, seemed to indicate that after the Asian Tsunami in December 2004, the fishermen in Kuala Teriang were putting more efforts for trammel netting which led to reduced CPUE.

**Conclusions**

The status of the marine resources in the fishing grounds of Kuala Teriang was monitored through the fishermen's catch composition and catch per unit effort. The CPUE and total landing indicated that the resources are overfished. Therefore, the resources need to be monitored continuously and good management of the resources should be necessary and should be put in place.

Most of the fishes were caught at the sites near the existing FADs. At the new artificial reefs areas, the catch was observed to be very poor. FADs should also be attached to the concrete reefs to attract more fishes. The effectiveness of the artificial reefs could only be assessed after being underwater for more than 6 months (observation from other artificial reefs projects world-wide). The success of the FADs and artificial reefs in enhancing the fish stocks also depends on the surveillance efforts conducted by DOF Malaysia. Encroachment of trawlers and purse-seiners in the project site were still observed and thus, should be deterred.

The fishermen involved in this project were very enthusiastic about the success of the LBCRM–PL project. The past four years saw the project steadily taking its pace, gaining momentum, and nurturing the interest of the public on their participation in fishery resource management. The project created a dynamic wave of awareness in conservation and sustainable exploitation of the fishery resources in Kuala Teriang waters. This concept of community-based resource management should be extended to other areas of Malaysia.

**Acknowledgements**

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## References

Penchan Luangmanee. 2006. Report on Marine Resources Monitoring in Langkawi ( 2004-2006). Unpublished report.

**Table 4. CPUE of fishing gear in Kuala Teriang**

| Fishing gear | Month | CPUE | | | No. of records | Source of data |
|---|---|---|---|---|---|---|
| | | Min | Max | Average | | |
| Shrimp trammel net (kg/net/trip) | Jun04 | 0.18 | 7.96 | 2.47 | 15 | landing |
| | Aug04 | 0.20 | 7.78 | 1.23 | 48 | Logbook |
| | Sep04 | 0.20 | 2.96 | 1.19 | 48 | Logbook |
| | Oct04 | 0.21 | 1.54 | 0.71 | 44 | Logbook |
| | Nov04 | 0.40 | 5.67 | 1.77 | 24 | Logbook |
| | Aug05 | 0.11 | 2.61 | 0.70 | 87 | Logbook+landing |
| | Sep05 | 0.11 | 3.83 | 0.66 | 109 | Logbook |
| | Oct05 | 0.10 | 3.83 | 0.52 | 111 | Logbook |
| | Nov05 | 0.14 | 1.05 | 0.50 | 68 | Logbook+landing |
| | Jan06 | 0.08 | 0.83 | 0.37 | 15 | Logbook |
| | Feb06 | 0.12 | 0.98 | 0.50 | 101 | Logbook |
| | Mar06 | 0.10 | 3.01 | 0.87 | 96 | Logbook |
| | Apr06 | 0.08 | 2.93 | 0.76 | 102 | Logbook |
| | May06 | 0.20 | 2.72 | 0.74 | 86 | Logbook |
| | Jun06 | 0.09 | 1.22 | 0.46 | 72 | Logbook |
| | Jul06 | 0.05 | 1.39 | 0.53 | 143 | Logbook |
| | Aug06 | 0.10 | 0.92 | 0.36 | 74 | Logbook |
| | Sep06 | 0.16 | 1.30 | 0.48 | 56 | Logbook |
| | Oct06 | 0.08 | 1.96 | 0.48 | 64 | Logbook |
| | Nov06 | 0.07 | 0.99 | 0.48 | 37 | Logbook |
| Bottom vertical longline (kg/100 hooks/trip) | Jun04 | 3.07 | 3.24 | 3.15 | 2 | landing |
| | Aug04 | 3.78 | 9.91 | 7.25 | 3 | logbook |
| | Sep04 | 1.65 | 35.83 | 12.07 | 9 | logbook |
| | Oct04 | 3.04 | 26.52 | 12.36 | 16 | logbook |
| | Nov04 | 3.87 | 17.83 | 9.33 | 6 | logbook |
| | Dec04 | 6.10 | 9.02 | 7.56 | 2 | landing |
| | Jan06 | 4.50 | 10.83 | 8.19 | 7 | logbook |
| | Feb06 | 2.17 | 9.41 | 5.79 | 2 | logbook |
| | Apr06 | 5.78 | 25.27 | 13.17 | 6 | logbook |
| Pomfret gill net (kg/net/trip) | Apr06 | - | - | 0.60 | 1 | logbook |
| | May06 | 0.08 | 1.57 | 0.57 | 14 | logbook |
| | Feb06 | 0.24 | 0.46 | 0.35 | 2 | logbook |
| | Jan06 | - | - | 0.20 | 1 | logbook |
| Fish gill net (kg/net/trip) | Jun04 | 2.86 | 6.58 | 4.44 | 3 | Landing |
| | Nov06 | 1.11 | 14.38 | 5.87 | 4 | logbook |
| | Apr06 | 0.84 | 4.13 | 2.23 | 6 | logbook |
| | May06 | 0.40 | 18.38 | 7.80 | 21 | logbook |
| | Jun06 | 2.64 | 12.22 | 6.00 | 10 | logbook |
| | Jan06 | - | - | 2.75 | 1 | logbook |
| Squid cast net (kg/trip) | Nov04 | 2.20 | 14.00 | 7.02 | 9 | landing |
| | Dec04 | 12.50 | 25.00 | 18.11 | 10 | logbook |
| Crab gill net (kg/net/trip) | Jun04 | 0.27 | 2.59 | 1.13 | 3 | landing |